

## 2.

Deep-sea Fishes of the Bermuda Oceanographic Expeditions.  
Family Paralepididae.<sup>1</sup>

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(Text-figures 1-9).

## CONTENTS.

	Page
Introduction .....	17
Acknowledgments .....	17
Explanation of Morphological Figures .....	17
Methods for Counts and Measurements .....	18
Family Paralepididae .....	18
Genus <i>Paralepis</i> Cuvier .....	18
<i>Paralepis brevirostris</i> (Parr) .....	19
<i>Paralepis brevis</i> (Zugmayer) .....	23
<i>Paralepis coregonoides</i> (Risso) .....	25
Genus <i>Notolepis</i> Dollo .....	25
<i>Notolepis rissoi</i> (Bonaparte) .....	25
Genus <i>Lestidium</i> Gilbert .....	26
<i>Lestidium affine</i> (Ege) .....	26
<i>Lestidium pseudosphraenoides danae</i> (Ege) .....	27
Genus <i>Macroparalepis</i> Ege .....	29
<i>Macroparalepis brevis</i> Ege .....	29
<i>Macroparalepis affine</i> Ege .....	31
<i>Macroparalepis danae</i> Ege .....	32
Genus <i>Stemonosudis</i> , new .....	32
<i>Stemonosudis intermedia</i> (Ege) .....	32
Genus <i>Sudis</i> Rafinesque .....	33
<i>Sudis hyalina</i> Rafinesque .....	33
Literature Cited .....	35

## INTRODUCTION.

The Bermuda Oceanographic Expeditions of the New York Zoological Society, under the direction of Dr. William Beebe, obtained a very interesting and valuable collection of paralepids, comprising several hundred specimens, of which approximately 250 have been sent to me for study. The remainder of the material could not be located. This material provides a new genus, *Stemonosudis*, the second records for *Macroparalepis brevis*, *M. danae*, *Stemonosudis intermedia* and *Lestidium affine*, the third record for *Macroparalepis affine*, and the first complete ontogenetic series of *Paralepis brevirostris*. In addition the writer gives the first extensive description since the middle 1800's of adults of the remarkable *Sudis hyalina*. Examples of the family Paralepididae are rare in most museums and thus it is of interest to report that most of the Bermuda material has been deposited at Stanford University. A duplicate series has been retained by the New York Zoological Society. In addition to the Bermuda collections, Atlantic material from Mr. G. E. Maul of the Museu do Funchal, Madeira, from the H. H. Giglioli Collection at the Museo di Storia Naturale, Roma, and from the British Museum (Natural History), has been incorporated in this paper. The work was done in the Natural History Museum of Stanford University.

<sup>1</sup> Contribution No. 892, Department of Tropical Research, New York Zoological Society.

Beebe (1937), in his preliminary list of Bermuda deep-sea fishes, lists tentative determinations of 753 paralepids, consisting of three genera (*Luciosudis*, *Paralepis* and *Macroparalepis*) and seven species. The genus *Luciosudis* is not included in the present report because it does not belong to the family Paralepididae, but instead to the sub-order Myctophoidea in the neighborhood of the family Chlorophthalmidae. The specimen of *Macroparalepis intermedius* is here included as *Stemonosudis intermedia*. *Paralepis bronsoni* and *P. speciosus*? are included under *P. brevis*. *Paralepis brevirostris* and *P. brevis* are left as originally determined.

For data in regard to nets, localities, depths, etc., concerning the capture of paralepids treated in this report, the reader may refer to the articles by Dr. Beebe in *Zoologica* (1931a, 1931b, 1932, 1936).

The classification and methods of investigation here used are explained in detail in a series of papers by the present author under the title "Studies on the bathypelagic fishes of the family Paralepididae" now in press in *Pacific Science*. A considerable part of the results of this study of the Bermuda material is included in the studies referred to, and in order to reduce duplication to a minimum, the present paper can be considered as number four of the series.

## ACKNOWLEDGMENTS.

I am greatly indebted to the New York Zoological Society and also to Dr. William Beebe and Mr. John Tee-Van for allowing me to examine the Bermuda material and for their considerate cooperation during the preparation of this report. I also wish to thank Dr. Enrico Tortonese for helping me locate material of *Sudis hyalina* and Mr. G. E. Maul for supplying valuable paralepids.

## EXPLANATION OF MORPHOLOGICAL FIGURES.

The full-page morphological figures have been prepared in a standard manner to facilitate comparison of some of the more important morphological characters. Similar illustrations of other genera and species will be found in the author's papers mentioned above.

*Figure A.*—Anterior part of snout. The teeth that are solid black are depressible;

the remainder are fixed. The buccal valves and supramaxillary membranes are stippled. The nostrils on the snout and the larger pores on the lower jaw are indicated.

*Figure B.*—An enlarged section of the fixed teeth on the middle of the premaxillary viewed laterally.

*Figure C.*—The anterior lateral-line segments on the left side. The area with longitudinal parallel lines delimits the partly ossified center shield in the naked genera (*Lestidium* and *Macroparalepis*) and the central row of scales in the scaled genus *Paralepis*. The crossed lines indicate the scales above and below the middle lateral-line row.

*Figure D.*—A section of the ceratobranchial of the first right arch showing the gill-teeth. The parallel lines indicate the gill arch.

*Figure E.*—Dorsal surface of tongue (glossohyal) and anterior portion of first basibranchial. The stippled area represents the fleshy tongue. The glossohyal and basibranchial are indicated by longitudinal parallel lines. The small hooked circles indicate the teeth.

#### METHODS FOR COUNTS AND MEASUREMENTS.

The methods used here for counts and measurements are explained in order to avoid confusion. In general they are the same as presented by Hubbs & Lagler (1947).

*Measurements.*—The *standard length* is the distance from the anterior tip of the snout to the base of the caudal fin. The *body length* is the distance from the posterior tip of the operculum to the base of the caudal fin. The *body depth* is the greatest dimension, exclusive of the fleshy or scaly structures which pertain to the fin bases. It is not of much use due to the irregular development and preservation of the carinae. The *caudal peduncle length* is the oblique distance between the end of the dorsal base and mid-base of the caudal fin. The *head length* is the distance from the tip of the snout (upper jaw) to the most distant point on the opercular margin including membranous flaps. The *eye diameter* is the greatest distance between the free orbital rims. The *interorbital width* is the least bony width. The *upper jaw length* is the distance between the tip of the snout and the posteriormost point of the maxillary. The *predorsal*, *preanal* and *prepelvic* distances are the lengths between the anterior tip of the snout and the origins of the corresponding fins. Note that *preanal* is used here in respect to the anal fin, while Ege uses this term in relation to the anus. The *dorsal to pelvic distance* is the length between the dorsal fin origin and a vertical from the pelvic fin origin. The percentages and proportions were calculated mathematically.

*Counts.*—The last two closely applied fin rays in the dorsal and anal fins are counted as one. The number of pelvic rays include the outer closely applied rays which are fairly

short and the inner rays that are imbedded in the flesh and easily overlooked. The caudal fin count is the number of principal rays only, and includes the branched rays plus one unbranched ray on each side. The upper caudal rays are given first in each count. In regard to dentition on the gill arch it is fully realized that true gillrakers are not known in any families of the suborder Alepisauroidea. Instead the gill arches are armed with teeth (termed "gill-teeth" by various authors) characteristically arranged on bony basal elements. However, for convenience in this study and for want of a better term, I have called each bony base a gillraker and have paid particular attention to the distribution of teeth (gill-teeth) on these "rakers." The distribution and form of the gill arch teeth provide convenient characters for distinguishing most of the paralepid genera.

#### FAMILY PARALEPIDIDAE.

The Paralepididae form the second largest family in the order Iniomi (Myctophidae is the largest by far), consisting of seven genera and approximately 45 known species. The Bermuda material includes at least eight species (because some specimens had become dried out, all the species represented are not included) and all genera but *Notolepis* and *Sudis*. The family belongs to the suborder Alepisauroidea and is most closely related to the families Scopelarchidae, Evermannellidae and Omosudidae. The basic recent papers on Atlantic paralepids are by Ege (1930, 1933), Parr (1928, 1929, 1931), and Maul (1945). A discussion of these contributions is given by the present author (in press).

The superficial family characters in brief are: Body slender and elongate. Eye normal, directed laterally. Symphysis of lower jaw more or less elevated. There is a corresponding arched, toothless notch in the upper jaw. Angle of gape well before vertical from anterior margin of eye. Supramaxillary present, splinter-like, approximately one-half the length of the maxillary. Teeth on vomer absent or consisting of one or two minute teeth. Teeth on palatines fairly short, not entering into the lateral profile when mouth is open. Teeth on tongue tiny, if present. Dorsal fin with few rays, far back on body, behind pectoral fins and middle of body length. Anus in region of pelvic fins.

#### Genus *Paralepis* Cuvier.

The genus *Paralepis* is primarily characterized by (1) the presence of a foramen in the anterior process of the premaxillary, (2) upper jaw reaching to or slightly beyond a vertical from anterior border of eye, (3) supramaxillary free from maxillary except at its posterior insertion, (4) teeth on lower jaw short and weak, basally round, (5) gill-teeth consisting of a series of bony bases each armed with numerous teeth in several rows, the anteriormost gill-teeth prolonged, (6) body scaled in adults. The genus *Paralepis* includes six species, of which *P.*

*elongata* (Brauer), *P. speciosa* Bellotti and *P. danae* Ege (1933) are not included in the present paper.

Despite careful search, no specimens were found in the Bermuda collection which seemed to agree with *Paralepis bronsoni* (Parr). This is strange, considering the wide distribution of species of this genus and the intensive collecting that was carried out reasonably near the type locality (Bahamas) of *P. bronsoni*. Since the subadults of the very similar *P. brevirostris* (Parr) have such a large number of premaxillary teeth it might be possible that Parr's specimen was precocious in development and is

actually an aberrant example of *P. brevirostris*. Both Ege and I are inclined to believe that *P. bronsoni* is an unusual or abnormal specimen of *P. brevirostris*.

***Paralepis brevirostris* (Parr).**

Text-figs. 1-3.

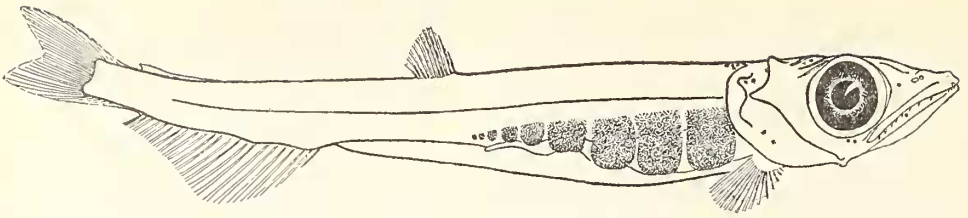
*Specimens Taken by the Bermuda Oceanographic Expeditions.*—Fifty-nine specimens, 8.5-50.0 mm. in standard length; April 29, 1929, to July 24, 1934, at 25 to 2,000 fathoms; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

- No. 9,589; net 34; 700 F.; April 29, 1929; 24.9 mm.  
 No. 9,615; net 47; 600 F.; April 29, 1929; 26.0 mm.  
 No. 9,815; net 78; 600 F.; May 8, 1929; 29.0 mm.  
 No. 9,900; net 89; 600 F.; May 10, 1929; 32.0 mm.  
 No. 9,952; net 100; 600 F.; May 14, 1929; 31.5, 32.3 mm.  
 No. 10,094; net 117; 900 F.; May 18, 1929; 12.5 mm.  
 No. 10,253a; net 135; 600 F.; May 30, 1929; 12.3 mm.  
 No. 10,727; net 195; 700 F.; June 20, 1929; 25.3 mm.  
 No. 24,080; net 205; 500 F.; June 22, 1929; 16.3 mm.  
 No. 24,087; net 217; 500 F.; June 24, 1929; 13.3 mm.  
 No. 24,106; net 243; 600 F.; July 1, 1929; 13.2 mm.  
 No. 11,267; net 259; 1000 F.; July 5, 1929; 11.8 mm.  
 No. 11,293a; net 260; 500 F.; July 6, 1929; 11.8, 12.2 mm.  
 No. 11,633; net 305; 600 F.; July 16, 1929; 42.7 mm.  
 No. 12,119; net 356; 700 F.; Aug. 9, 1929; 10.7 mm.  
 No. 13,636; net 356; 700 F.; Aug. 9, 1929; 16.7, 19.4 mm.  
 No. 12,433; net 382; 900 F.; Aug. 16, 1929; 14.5 mm.  
 No. 13,171a; net 432; 700 F.; Sept. 6, 1929; }  
 No. 13,733a; net 497; 1000 F.; Sept. 23, 1929; } 3 specimens  
 No. 13,735; net 497; 1000 F.; Sept. 23, 1929 } 16.5-21.0 mm.  
 No. 15,497; net 645; 600 F.; May 29, 1930; 9.3 mm.  
 No. 17,388; net 746; 800 F.; June 30, 1930; 8.5 mm.  
 No. 17,389; net 804; 500 F.; July 16, 1930; 12.5 mm.  
 No. 17,829; net 843; 700 F.; Sept. 4, 1930; }  
 No. 17,838; net 844; 800 F.; Sept. 4, 1930; } 21.8, 23.5 mm.  
 No. 18,284; net 865; 600 F.; Sept. 10, 1930; 18.6 mm.  
 No. 20,703; net 1003; 500 F.; June 6, 1931; 19.0 mm.  
 No. 20,714; net 1007; 800 F.; June 6, 1931; 35.7 mm.  
 No. 20,775; net 1008; 600 F.; June 6, 1931; 43.4 mm.  
 No. 20,868; net 1021; 600 F.; June 16, 1931; 16.3 mm.  
 No. 21,080; net 1052; 300 F.; July 6, 1931; 13.2 mm.  
 No. 21,431a; net 1084; 25 F.; July 11, 1931; 11.1 mm.  
 No. 21,481; net 1095; 600 F.; July 24, 1931; 35.0 mm.  
 No. 21,753; net 1119; 400 F.; Aug. 3, 1931; 3 specimens 12.7-13.0 mm.  
 No. 21,934; net 1137; 600 F.; Aug. 6, 1931; } 38.7 mm.  
 No. 21,944; net 1138; 600 F.; Aug. 6, 1931; }  
 No. 22,536; net 1198; 1000 F.; Aug. 17, 1931; 13.8 mm.  
 No. 22,716; net 1213; 900 F.; Aug. 21, 1931; 15.8, 18.9 mm.  
 No. 22,862; net 1239; 900 F.; Aug. 29, 1931; 22.3 mm.  
 No. 23,066; net 1257; 800 F.; Sept. 3, 1931; 12.4 mm.  
 No. 23,104; net 1261; 600 F.; Sept. 4, 1931; 12.3 mm.  
 No. 23,167; net 1271; 600 F.; Aug. 7, 1931; }  
 No. 23,207; net 1275; 1000 F.; Aug. 7, 1931; } 4 specimens 14.6-28.5 mm.  
 No. 23,259; net 1282; 500 F.; Aug. 10, 1931; }  
 No. 23,283; net 1285; 800 F.; Aug. 10, 1931; } 3 specimens 16.5-23.4 mm.  
 Nol 23, 295; net 1288; 2000 F.; Aug. 11, 1931; 50.0 mm.  
 No. 23,298; net 1290; 500 F.; Sept. 12, 1931; 12.5, 13.3 mm.  
 No. 23,590; net 1313; 500 F.; Sept. 17, 1931; 15.0 mm.  
 No. 23,665; net 1326; 600 F.; Aug. 19, 1931; part of body  
 No. 23,897; net 1332; 600 F.; Oct. 28, 1931; 25.9 mm.  
 No. 24,372; net 1501; 400 F.; July 24, 1934; 15.0 mm.

*Other Study Material.*—Two specimens, 68.9 and 135.5 mm. in standard length; originally Museu do Funchal nos. 2484 and 2983; larger specimen now Stanford no. 15081; collected from the stomachs of *Alepisaurus ferox* Lowe near Madeira, North

Atlantic; obtained from G. E. Maul. These specimens were described by Maul (1945, p. 9).

*Specimens Previously Recorded.*—Twenty-six specimens, 53-195 mm. in standard length, have been recorded in the literature by Parr



TEXT-FIG. 1. Post-larva, 13.4 mm. in standard length, of *Paralepis brevirostris* (Parr). All pigmentation that can be seen when viewed laterally is indicated. The occiput and nape are heavily pigmented, but this coloration is not included in the illustration because the top of the head is broad and flat. Note the broad base of the pectoral fin, the extension of the fin far under the head, and the considerably shortened anterior rays. The pectoral fin moves posteriorly in later growth stages, the base becomes considerably more restricted, and the anterior rays become longer correspondent to the other pectoral rays.

(1928, p. 42; 2 types from off the Bahama Islands. 1929, p. 31; osteology of one of the types) and Maul (1945, p. 9; 24 specimens collected from the stomachs of *Alepisaurus ferox* Lowe taken near Madeira). For the complete history of this species see Parr (1928, 1931), Ege (1930) and Maul (1945).

*Post-Larval Development.*—The smallest specimen previously described is the holotype, 53 mm. in standard length, from off the Bahamas. The description of the osteology of this form by Parr (1929) must also be of an adolescent or juvenile. Maul (1945) described specimens down to 56 mm. in length from off Madeira, but he did not give particular attention to the ontogeny displayed by his material. Nevertheless, there appears to be no reason to doubt that all of Maul's material belongs to this species. In order to facilitate uniformity in work done on North Atlantic paralepids, the style of Ege (1930) has been fairly closely followed in presenting descriptions of the various growth stages of *Paralepis brevirostris*. Particular attention has been paid to comparison of this form with its closest relative, *Paralepis speciosa* Bellotti, as presented by Ege (1930, p. 51). It can be easily seen that the larval stages of these two species are remarkably different. The primary differences reside in the facts (1) that *P. brevirostris* is distinctly larger than *P. speciosa* at corresponding growth stages, and (2) that the former species is much more heavily pigmented in every stage.

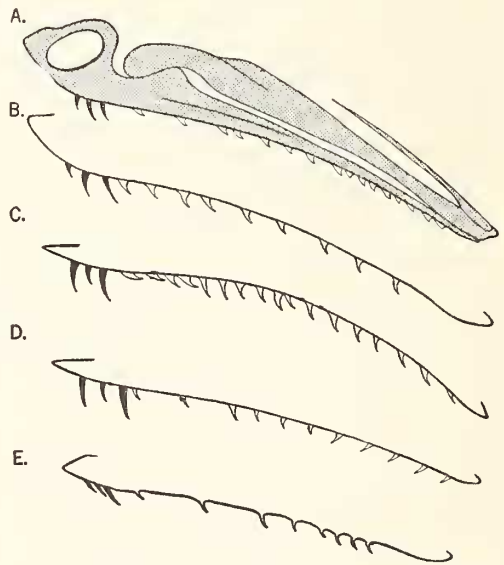
*Post-larva 13.1 mm. in Standard Length.*

—All of the fins and fin rays are fully developed, except that the pelvics are still lacking. The fin rays can all be counted and the supplementary caudal rays are suggested. The embryonic fin fold is almost completely reduced in front of the well developed adipose fin; ventrally a deep fin extends from below the pectorals to the anal fin origin, but is only slightly evident between anal and caudal fins. There are nine closely spaced peritoneal color segments of which the first is the largest. The peritoneal segments extend far down the sides and these patches become progressively smaller posteriorly so that the last four are reduced to small spots. The four anterior segments cover the stomach. The

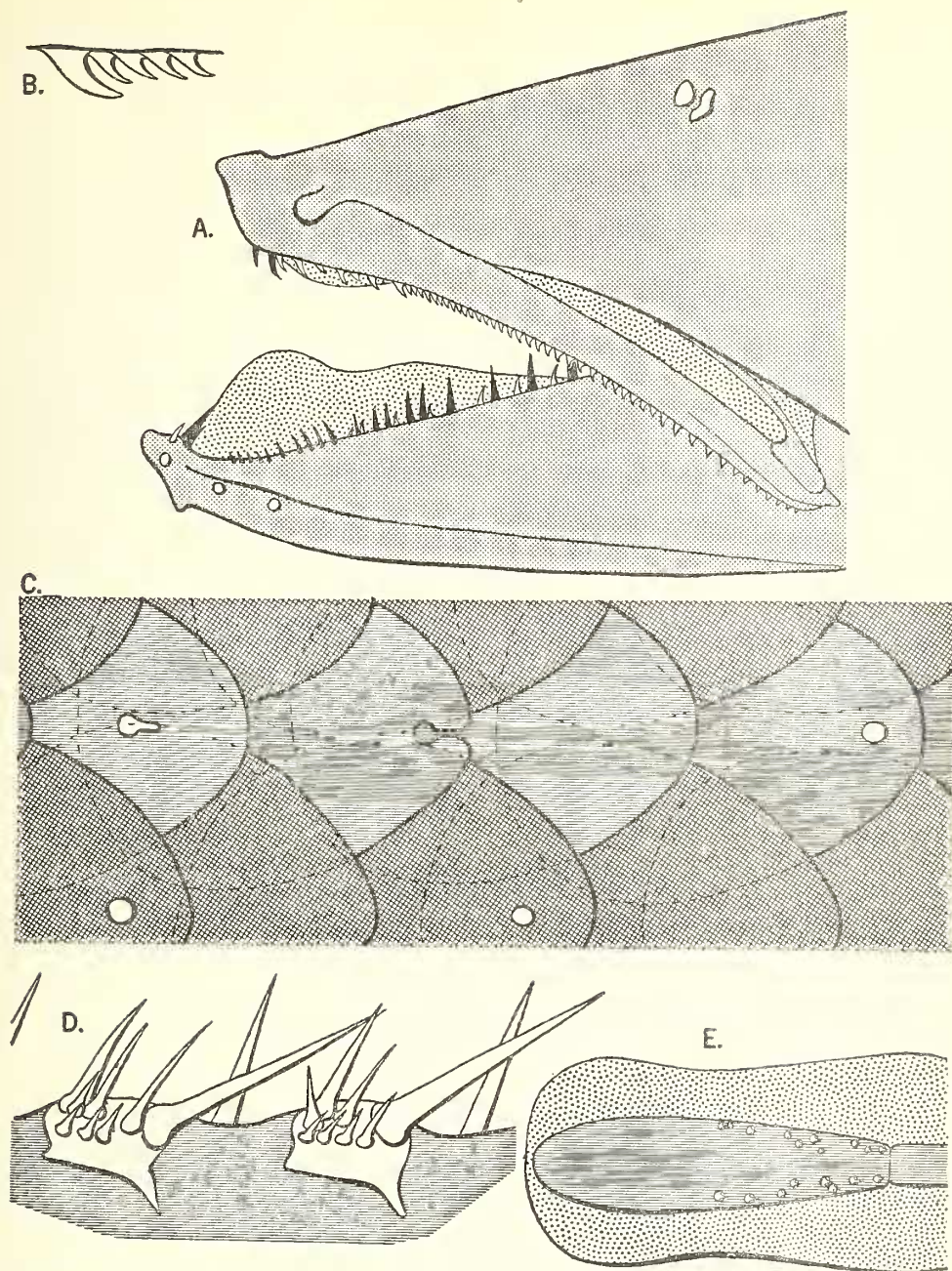
occiput and nape are heavily pigmented. Scattered chromatophores before eye and on posterior tip of upper jaw. Otherwise no pigmentation on head and body.

*Post-larva 23.4 mm. in Standard Length.*

—The pelvic fins are slightly posterior to the anus, but the rays are not discernible. The adipose fin is sharply defined, but is still preceded by a very low embryonic fin fold; ventrally the embryonic fin extends from below the pectoral fins to the anal fin but is



TEXT-FIG. 2. Upper jaw of various growth stages of *Paralepis brevirostris* (Parr). The solid black teeth are depressible and are inserted on the inner face of the premaxillary; the remainder are fixed and are situated on the edge of the premaxillary. A. 50.0 mm. in standard length. B. 35.0 mm. C. 26.0 mm. D. 13.2 mm. E. 9.3 mm. The maxillary bones have been drawn in A. The premaxillary is denticulated and contains a large anterior foramen. The next largest bone is the maxillary, and the small slender bone anteriorly free is the supramaxillary. This series shows that while there is a general trend for the increase in number of fixed teeth in subsequent growth stages, there is considerable individual variation. In most paralepids the number of premaxillary teeth is highly variable, even within definite growth stages.



TEXT-FIG. 3. Adult of *Paralepis brevirostris* (Parr) 135.6 mm. in standard length. See "Explanation of Morphological Figures" (Pages 16 & 17).

well developed only between the anus and anal fin; embryonic fold only slightly evident between anal and caudal fins. Anus below middle of dorsal fin. There are six closely spaced peritoneal color segments which are confined to the sides of the abdominal cavity, extending far down ventrally. The posterior two peritoneal segments are less than one-third the size of the fourth; the first four segments are nearly the same size, but the first is the largest. The remainder of the pigmentation is quite different from the

preceding stage. The dorsum is heavily pigmented from occiput to dorsal origin and with slightly scattered chromatophores half-way down over the sides. The hind-dorsal stripe continues on the sides, below the dorsal fin, back to under the adipose fin; this section is confined to above the vertebral column. There are scattered chromatophores on the gular region, snout and particularly on the postorbital part of the head.

Adolescent 31.5 mm. in Standard Length. — The proportions and appearance of the

adult have been somewhat developed by this stage. The dorsal portion of the embryonic fin has disappeared; ventrally it is developed from under the third peritoneal color segment to the anal fin origin. The pelvic fins are fully formed below the dorsal fin and the rays can be counted. There are five large, distinct, closely spaced peritoneal color segments which posteriorly blend into the solid pigmentation of the body. The head and body are heavily pigmented except on the belly and opercles. The body is solidly pigmented above and behind the peritoneal segments, particularly so in the mid-dorsal stripe. The head is heavily pigmented on post-orbital, nape, occiput and tip of snout; scattered chromatophores elsewhere. The fins lack pigment, except the bases of the anterior rays of the dorsal fin and the upper pectoral ray. Gill-teeth and pharyngobranchial teeth are not developed. The lateral-line tube is poorly developed, but the body skin is densely penetrated by minute pores, forming a striking parallel to the condition found in the adults of the families Anotopteridae and Alepisauridae. Each lateral-line segment has a single median pore. This is of particular interest since the most primitive genus in the family (new genus, in press) has this same condition in the adult of a single pore for each lateral-line section. A few of the lateral-line and neighboring scales are developed (these were discerned by superficially staining with Alizarin Red S).

*Adolescent 43.4 mm. in Standard Length.*—This specimen is essentially the same as the previously described adolescent, except that it is less pigmented. There are nine peritoneal color segments, the pigmentation on the body is restricted to the dorsum and the sides over the anal fin. The anus is slightly behind the pelvic fin base and a vertical from the dorsal fin base. No scales evident. The lateral-line as in the previous stage. Gill-teeth just beginning to develop; each spinous raker consisting of one or two short, sharp, conical teeth. The bony raker bases have not yet developed. Pharyngobranchial teeth not developed.

*Juvenile 50.0 mm. in Standard Length.*—The gill-teeth are essentially fully developed on each arch with approximately 4-6 subequal spines on each bony raker base. Some of the pharyngobranchial teeth are developed. Lateral-line segments fully developed and ossified, but still a single pore for each segment. A few scales developed in the lateral-line region. Otherwise this specimen is essentially the same as the previous example described.

*Subadult 68.9 mm. in Standard Length.*—Scales well developed in the lateral-line region. The adult pore pattern along the lateral-line is now evident. The gill-teeth are longer than in previous stage and either the anteriormost or the inner middle spine

is the longest on each bony base. Pharyngobranchial teeth well developed. The peritoneal segments (eight in number) are reduced and weakly pigmented.

*Adult 135.6 mm. in Standard Length.*—The adults of this species have been carefully described by Maul (1945), including this specimen, but additional notes are presented in the light of my own investigations.

Interorbital concave with two pairs of low sharp ridges near the orbital margins; these ridges strongly diverge laterally on occiput: the inner pair of ridges converge anteriorly on snout and unite behind the premaxillary process; the outer two ridges are parallel to the inner ridges and converge (but do not join) behind premaxillary process. Maxillary terminates slightly before a vertical from the anterior border of the eye. Posterior tip of supramaxillary broad, flat, inserted on the outer face of the maxillary. Nostrils approximately one-third the length of the upper jaw in front of a vertical from the posterior tip of the maxillary. Premaxillary anteriorly with three small depressible canines followed by nine small, irregularly arranged, retrorse teeth; abruptly behind these teeth are 44 tiny, closely spaced, sub-equal, retrorse canines. Tip of lower jaw blunt, lacking any trace of anterior unossified projections. Vomer toothless. Palatines anteriorly with two large, fixed, retrorse canines and five long, depressible canines; posteriorly a single row of 10 various-sized, fixed, retrorse canines. Last palatine tooth slightly behind angle of gape. Tongue large, with two longitudinal rows of 8-10 teeth. Gill-teeth on all five arches. Each gillraker has approximately 5-12 depressible teeth in each bunch; the anterior and inner spines are the longest, and the anteriormost spine is particularly prolonged. Gill-teeth extend anteriorly to slightly behind a vertical from tip of upper jaw. On first arch, eight rakers on hypobranchial, nine on ceratobranchial, three above angle on epibranchial.

Lateral-line with 55 sections, terminating slightly behind a vertical from the middle of the anal fin. Lateral-line tube covered by two rows of scales; scales irregularly pierced by pores. The basic pattern appears to be a single median pore near the posterior margin in both scale rows. Often no pores present on scales. Lateral-line scales same shape and size as body scales. Each lateral-line scale is bordered above and below by one scale. The underlying segments of the lateral-line are only weakly ossified.

Anus at tips of appressed pelvic fins.

*Stomach Contents Recorded by Beebe.*—The stomach contents of 15 *Paralepis brevirostris* were examined before preservation and recorded by Dr. Beebe in his field notes. The length refers to standard length.

Number	Net	Length	Food
14,904	565	12 mm.	2 small <i>Phronima</i> .
15,309	621	13 mm.	small shrimp.
15,330	625	10 mm.	shrimp 8 mm.
15,338	626	12 mm.	2 small fish 8 mm.
15,831	686	15 mm.	small fish 12 mm.
16,119	719	16 mm.	2 oblique-eyed <i>Myctophum</i> larvae.
16,603	766	17 mm.	shrimp 10 mm.
16,853	792	14 mm.	4 large copepods.
17,013	798	17 mm.	small fish.
17,146	804	20 mm.	small fish 12 mm.
18,281	865	16 mm.	small fish 10 mm., small shrimp.
18,635	893	28 mm.	shrimp 16 mm.
19,568	967	14 mm.	2 myctophid larvae 8 mm.
19,568	967	29 mm.	4 small <i>Acanthephyra</i> .

*Paralepis brevis* (Zugmayer).

*Specimens Taken by the Bermuda-Oceanographic Expeditions.* — One hundred and sixty-eight specimens, 8.0-85 mm. in standard length; August 16, 1929, to October

28, 1931, at 300 to 1,000 fathoms; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

No. 11,646; net 307; 800 F.; July 16, 1929; 85 mm.	
No. 12,424; net 380; 700 F.; Aug. 16, 1929; 8 specimens 13.3-25.0 mm.	
No. 12,557; net 391; 600 F.; Aug. 19, 1929; }	18 specimens
No. 12,563; net 392; 700 F.; Aug. 19, 1929; }	
No. 12,576; net 393; 800 F.; Aug. 19, 1929; }	9.8-23.2 mm.
No. 17,006; net 797; 500 F.; July 15, 1930; }	
No. 17,390; net 797; 500 F.; July 15, 1930; }	4 specimens 9.4-22.4 mm.
No. 13,209; net 437; 500 F.; Sept. 7, 1929; }	
No. 13,221; net 439; 700 F.; Sept. 7, 1929; }	6 specimens 12.9-27.8 mm.
No. 13,693; net 493; 600 F.; Sept. 23, 1929; }	
No. 13,703; net 494; 700 F.; Sept. 23, 1929; }	6 specimens 13.4-23.0 mm.
No. 13,713; net 495; 800 F.; Sept. 23, 1929; }	
No. 12,632; net 486; 700 F.; Sept. 21, 1929; }	6 specimens 13.4-23.0 mm.
No. 13,638; net 487; 800 F.; Sept. 21, 1929; }	
No. 13,646; net 488; 900 F.; Sept. 21, 1929; }	6 specimens 13.4-23.0 mm.
No. 13,656; net 489; 1000 F.; Sept. 21, 1929; }	
No. 14,722; net 541; 800 F.; May 6, 1929; 9.8 mm.	
No. 14,823; net 551; 500 F.; May 9, 1929; 10.6 mm.	
No. 14,904; net 565; 500 F.; May 12, 1930; 9.7 mm.	
No. 14,906; net 565; 500 F.; May 12, 1930; 10.1 mm.	
No. 15,205; net 596; 600 F.; May 19, 1930; 13.0 mm.	
No. 15,277; net 618; 500 F.; May 22, 1930; 10.5, 10.6 mm.	
No. 15,309; net 621; 600 F.; May 22, 1930; 13.0 mm.	
No. 15,338; net 626; 500 F.; May 23, 1930; }	12.1, 12.1 mm.
No. 15,343; net 626; 500 F.; May 23, 1930; }	
No. 15,571; net 651; 500 F.; May 30, 1930; 13.2 mm.	
No. 15,575; net 652; 500 F.; May 30, 1930; 13.3 mm.	
No. 15,831; net 686; 800 F.; June 9, 1930; 16.0 mm.	
No. 15,890; net 694; 900 F.; June 12, 1930; 17.0 mm.	
No. 15,986; net 708; 500 F.; June 16, 1930; 13.3 mm.	
No. 16,119; net 719; 700 F.; June 25, 1930; 13.3 mm.	
No. 16,177; net 725; 500 F.; June 26, 1930; 10.4, 12.7 mm.	
No. 16,312; net 741; 1000 F.; June 28, 1930; 13.0 mm.	
No. 16,422; net 746; 800 F.; June 30, 1930; 12.2 mm.	
No. 16,440; net 754; 700 F.; July 1, 1930; 3 specimens 14.3-18.6 mm.	
No. 16,607; net 767; 800 F.; July 3, 1930; 14.0 mm.	
No. 16,716; net 781; 1000 F.; July 5, 1930; 12.4, 20.2 mm.	
No. 16,781; net 784; 500 F.; July 7, 1930; 12.1 mm.	
No. 16,775; net 785; 600 F.; July 7, 1930; 12.3, 18.1 mm.	
No. 16,846; net 791; 500 F.; July 9, 1930; 3 specimens 10.0-12.5 mm.	
No. 16,853; net 792; 600 F.; July 9, 1930; 12.0 mm.	
No. 17,013; net 798; 600 F.; July 15, 1930; 4 specimens 13.0-17.0 mm.	
No. 17,386; net 805; 600 F.; July 16, 1930; 3 specimens 11.3-14.8 mm.	
No. 18,693; net 901; 600 F.; Sept. 17, 1930; 19.5 mm.	
No. 19,221; net 934; 700 F.; Sept. 23, 1930; 14.7, 15.3 mm.	
No. 20,518; net 983; 500 F.; June 2, 1931; 11.6 mm.	
No. 20,644; net 995; 1000 F.; June 4, 1931; 10.8 mm.	
No. 20,778; net 1009; 900 F.; June 11, 1931; 10.4, 12.0 mm.	
No. 20,818; net 1016; 500 F.; June 15, 1931; 11.2 mm.	
No. 20,867; net 1021; 600 F.; June 16, 1931; }	6 specimens 11.8-13.0 mm.
No. 20,897; net 1026; 1000 F.; June 16, 1931; }	
No. 21,258; net 1073; 300 F.; July 10, 1931; 12.1 mm.	
No. 21,308; net 1078; 300 F.; July 11, 1931; 11.6 mm.	
No. 21,415; net 1086; 300 F.; July 15, 1931; 10.0 mm.	

No. 21,483; net 1095; 600 F.; July 24, 1931;	}	14.8, 15.6 mm.
No. 21,499; net 1099; 900 F.; July 24, 1931;		
No. 21,543; net 1102; 500 F.; July 25, 1931;	}	19.5, 21.2 mm.
No. 21,554; net 1103; 600 F.; July 25, 1931;		
No. 21,606; net 1107; 400 F.; July 27, 1931;	}	12 specimens 10.4-25.7 mm.
No. 21,618; net 1108; 500 F.; July 27, 1931;		
No. 21,637; net 1112; 900 F.; July 27, 1931;		
No. 21,683; net 1113; 400 F.; July 29, 1931;	}	4 specimens 10.6-21.1 mm.
No. 21,707; net 1115; 500 F.; July 29, 1931;		
No. 21,767; net 1120; 400 F.; Aug. 3, 1931;	}	3 specimens 11.6-18.0 mm.
No. 21,797; net 1121; 500 F.; Aug. 3, 1931;		
No. 21,843; net 1127; 900 F.; Aug. 4, 1931;	}	13.8 mm.
No. 21,934; net 1137; 600 F.; Aug. 6, 1931;		
No. 21,944; net 1138; 600 F.; Aug. 6, 1931;	}	17.3 mm.
No. 22,003; net 1144; 500 F.; Aug. 7, 1931;		
No. 22,018; net 1147; 700 F.; Aug. 7, 1931;	}	16.8, 19.6 mm.
No. 22,054; net 1150; 500 F.; Aug. 8, 1931;		
No. 22,065; net 1152; 600 F.; Aug. 8, 1931;	}	3 specimens 15.9-20.6 mm.
No. 22,074; net 1154; 700 F.; Aug. 8, 1931;		
No. 22,153; net 1155; 400 F.; Aug. 10, 1931;	}	5 specimens 11.1-22.6 mm.
No. 22,158; net 1156; 500 F.; Aug. 10, 1931;		
No. 22,325; net 1175; 600 F.; Aug. 14, 1931;	}	3 specimens 14.5-20.7 mm.
No. 22,398; net 1182; 700 F.; Aug. 15, 1931;		
No. 22,649; net 1205; 700 F.; Aug. 20, 1931;	}	22.7, 23.8 mm.
No. 22,776; net 1218; 700 F.; Aug. 24, 1931;		
No. 22,779; net 1222; 1000 F.; Aug. 24, 1931;	}	22.0, 27.3 mm.
No. 22,794; net 1227; 400 F.; Aug. 27, 1931;		
No. 22,801; net 1228; 500 F.; Aug. 27, 1931;	}	3 specimens 10.5-21.5 mm.
No. 22,802; net 1229; 800 F.; Aug. 27, 1931;		
No. 22,945; net 1242; 600 F.; Aug. 31, 1931;	}	15.8, 18.7 mm.
No. 23,168; net 1271; 600 F.; Aug. 7, 1931;		
No. 23,211; net 1276; 500 F.; Aug. 9, 1931;	}	9.8, 10.0 mm.
No. 23,220; net 1277; 600 F.; Aug. 9, 1931;		
No. 23,231; net 1278; 700 F.; Aug. 9, 1931;	}	16.5, 23.9 mm.
No. 23,260; net 1282; 500 F.; Aug. 10, 1931;		
No. 23,267; net 1283; 600 F.; Aug. 10, 1931;	}	5 specimens 21.4-35.6 mm.
No. 23,291; net 1287; 1000 F.; Aug. 10, 1931;		
No. 23,325; net 1293; 800 F.; Sept. 12, 1931;	}	16.3, 30 mm.
No. 23,333; net 1295; 1000 F.; Sept. 12, 1931;		
No. 23,374; net 1299; 900 F.; Sept. 14, 1931;	}	19.0 mm.
No. 23,419; net 1305; 500 F.; Sept. 15, 1931;		
No. 23,562; net 1314; 600 F.; Sept. 17, 1931;	}	23.6, 25.8 mm.
No. 23,661; net 1325; 500 F.; Aug. 19, 1931;		
No. 23,667; net 1326; 600 F.; Aug. 19, 1931;	}	3 specimens 18.3-35.7 mm.
No. 23,898; net 1332; 600 F.; Oct. 28, 1931;		

*Other Study Material Examined.*—One specimen 98.5 mm. in standard length; originally Museu do Funchal no. 3021; now Stanford no. 15082; collected from the stomach of *Alepisaurus ferox* Lowe (caught on a tunny-hook at about 100 fathoms) from near Madeira, North Atlantic; obtained from G. E. Maul.

*Specimens Previously Recorded.*—Approximately 35 specimens from larvae to adults described by many authors. See Ege (1930) and Maul (1945) for history and synonymy.

*Description of Material.*—Ege (1930) has already described and figured the early post-embryonic growth stages and several authors have described the adults. Certain adult characters are here described in more detail.

Interorbital deeply concave with two pairs of low sharp longitudinal ridges near orbital margins on each side; the inner ridges diverge somewhat laterally on occiput. The outer pair of ridges is confined to the interorbital. The inner ridges extend forward to premaxillary processes, but do not converge or unite. Premaxillary anteriorly with five fairly short, depressible canines followed by

49 tiny, closely spaced, retrorse teeth. The fixed teeth become progressively larger posteriorly, except for the last two much smaller teeth. Tip of lower jaw blunt, rounded, lacking anterior unossified prolongations. Vomer toothless. Palatines anteriorly with three short depressible canines, each accompanied by a shorter fixed tooth; posteriorly 14 fixed teeth extending far behind angle of gape. Teeth on all five gill arches. Each bony base on first arch has approximately 4-7 depressible spines in a bunch; the anterior spines are the longest. Teeth begin slightly before a vertical from anterior border of eye. On first arch, 10 rakers on hypobranchial, 18 on ceratobranchial, and eight above angle on epibranchial.

*Field Color Notes Prepared by Beebe.*—No. 21,308, Net 1078, 12 mm. Post-larva. The entire fish is white with black chromatophores arranged in patches as follows: on the tip of the snout, midway between tip of snout and eye, along the isthmus and margins of the jaws, and on the crown of the head. Several are located just behind the orbit, two at the dorsal origin, a large blotch at the origin of the anal, two below the



adipose and one on either side of the mid-line. The digestive organs are blackish and show prominently through the skin of the abdomen. Iris bluish-silver with violet reflections, overlaid anteriorly and dorsally with a great deal of pigment.

No. 22,776, Net 1218, 33 mm. Adolescent. General color white, with well developed black, dendritic chromatophores over the entire head and body except on the ventral side of the trunk. This is unmarked, save at the base of the anal and below the adipose,

No. 10,769; net 204; 1000 F.; June 21, 1929; 74 mm.

No. 22,001; net 1248; 600 F.; Sept. 1, 1929; }  
No. 22,996; net 1249; 700 F.; Sept. 1, 1929; } 11.7, 34.0 mm.

*Other Material Examined.*—Two specimens 139.7 (originally Museu do Funchal no. 2937) and 142.8 mm. (now Stanford no. 15,083) in standard length; from the stomachs of *Alepisaurus ferox* Lowe (caught on tunny-hook at about 100 fathoms); obtained from G. E. Maul. The larger specimen was described by Maul (1945, p. 22).

*Specimens Previously Recorded.*—Several hundred specimens from the North Atlantic. For synonymy and discussion see Ege (1930) and Maul (1945).

*Description of Madeira Material.*—The various growth stages of this species have been carefully described by several authors, but additional notes concerning the adults are presented in the light of my own investigations.

Interorbital strongly concave with two pairs of low, sharp ridges near the orbital margins on each side; posteriorly these ridges strongly diverge laterally on occiput; the inner pair of ridges converges anteriorly on snout and unites behind the premaxillary process. Premaxillary anteriorly with four tiny, depressible canines followed by 38 tiny, closely spaced, retrorse teeth. Tip of lower jaw blunt, lacking any trace of anterior unossified prolongations. Vomer toothless. In the larger specimen, palatines anteriorly with a single row of retrorse canines; two fixed teeth followed by a longer depressible canine, and approximately 13 short teeth. In other adult, palatines with three depressible canines followed by around 10 fixed teeth. Last palatine tooth far behind angle of gape in both specimens. Tongue toothless. Teeth on all five arches. All the bony rakers the same. Each bony raker base has approximately 5-10 depressible spines in a bunch; the anterior spines are the longest, and the anteriormost is particularly prolonged. Teeth begin distinctly before eye behind posterior tip of upper jaw. On first arch, 12 bony bases on hypobranchial, 14 on ceratobranchial, and six above angle on epibranchial.

Lateral-line with approximately 60 sections, terminating slightly behind a vertical from the middle of the anal fin. Lateral-line tube covered by two rows of scales; scales irregularly pierced by pores. The basic pattern is a single pore near the lower margins

where the characteristic larval pigment patches still remain. The pigment is densest along the dorsal mid-line. Iris silvery.

#### *Paralepis coregonoides* (Risso).

*Specimens Taken by the Bermuda Oceanographic Expeditions.*—Three specimens, 11.7-74 mm. in standard length; June 21 and Sept. 1, 1929, at 600 to 1,000 fathoms; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Berumda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

of both scale rows. Often no pores present or a single median pore on each side of the lower scale row. Each lateral-line scale same size as surrounding scales and bordered above and below by one scale. The underlying segments are only weakly ossified.

Anus above tips of appressed pelvic fins and behind a vertical from dorsal fin.

The Madeira specimen is illustrated in the generic review in press.

*Field Color Notes Prepared by Beebe.*—No. 10,769, Net 204, 90 mm. (before preservation). Body color pale flesh, probably where scales were; there is an irregular scattering of large dusky pigment cells. Dark on head, down dorsal ridge, and on the whole posterior two-fifths of the body. All fins black. Iris silvery. Gill covered with brilliant blue and green iridescence. Whole body cavity, from isthmus to anus, glittering, opaque silver with dark pigment showing at edges.

#### Genus *Notolepis* Dollo.

The genus *Notolepis* is primarily characterized by (1) the presence of a foramen in the anterior process of the premaxillary, (2) upper jaw terminating approximately an orbital diameter before the eye, (3) supramaxillary closely bound to maxillary, (4) teeth on lower jaw well developed, basally round, not reduced in adults, (5) gill-teeth numerous, sub-equal, in numerous rows, (6) body scaled in adults.

This genus includes three species of bipolar distribution: *Notolepis coatsi* Dollo (generic type) from the Antarctic, *N. rissoi* (Bonaparte) from the North Atlantic, and *N. coruscans* (Jordan & Gilbert) from the North Pacific. The Bermuda Expeditions did not obtain this genus, but I have examined an adult of *N. rissoi* obtained by the U.S.S. *Albatross* in 1886 that does not appear to have been recorded in the literature.

#### *Notolepis rissoi* (Bonaparte).

*Material Examined.*—One adult 251.5 mm. in standard length; Stanford no. 9491; Albatross station 2677; May 6, 1886; 32° 39' 00" N. Lat., 76° 50' 30" W. Long.

*Specimens Previously Recorded.*—Approximately 70 specimens from 13 to about

300 mm. in standard length, described by many authors from the eastern Atlantic. See Ege (1930) for history of this species.

*Description of Material.*—This specimen is partially digested, but fin ray counts and proportions clearly indicate that this is *N. rissoi* and very likely the subspecies *krøyeri* Lütken. This specimen is of particular interest since apparently it is the first record of a larger specimen from off the coast of the Americas. The only other report of the species from the western Atlantic appears to be Ege's record of two post-larvae from off the central Atlantic sea-board of the United States (1930, p. 105).

#### Genus *Lestidium* Gilbert.

The genus *Lestidium* is primarily characterized by (1) the presence of a foramen in the anterior process of the premaxillary, (2) upper jaw terminating at or well before a vertical from anterior border of eye, (3) supramaxillary closely bound to maxillary, (4) teeth on lower jaw well developed, basally round, not reduced in adults, (5) gill-teeth reduced, sub-equal, in a single row, (6) body naked, (7) lateral-line sections approximately as long as high, (9) dorsum of body evenly pigmented.

This genus is by far the largest in the family, including about 22 species, and is generally world-wide in distribution.

#### *Lestidium affine* (Ege).

##### Text-fig. 4.

*Specimens Taken by the Bermuda Oceanographic Expeditions.*—One specimen, 65.3 mm. in standard length; no. 20,779; net 1009; 900 fathoms; June 11, 1931; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

*Specimens Previously Recorded.*—At least 160 type specimens from post-larvae to sub-adults 103 mm. long, described by Ege (1930, p. 81), from the central and temperate North Atlantic. Neither holotype nor actual number of types was given. Apparently no other record has been published for this species.

*Description of Bermuda Juvenile.*—Body elongate, slender. Greatest depth at nape 14.8 into standard length. Ventral carina on belly and between anus and anal fin well developed. Dorsal carina before adipose fin a slight ridge. Caudal peduncle depth 5.6 into head; its length 2.8 into standard length. Anus above tips of appressed inner pelvic rays, situated slightly greater than an eye diameter before a vertical from the dorsal fin origin.

Head short, blunt, and fairly massive, slightly broader than body width; its length 6.2 into standard length. Snout short, distinctly less than one-half head length. Nasal apertures situated somewhat less than one-half the upper jaw length before its posterior tip. Eye vertically oval, its length 4.8 into head. Pupil obliquely oval. Postorbital

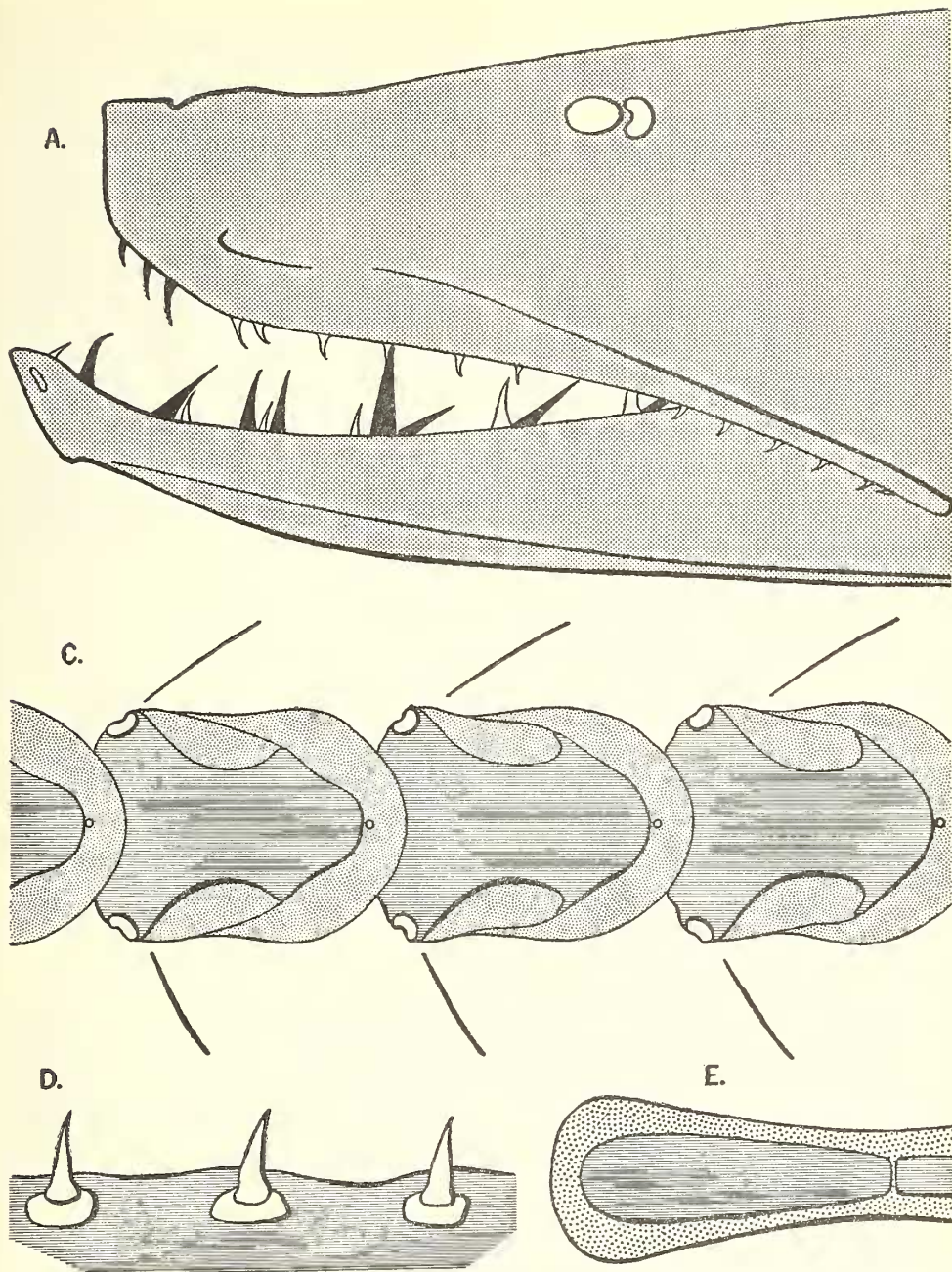
length less than snout length. Interorbital flat, its width 5.6 into head, with two longitudinal ridges; ridges of the inner pair are broad, low, rounded tubes, and those of the lateral pair are sharp, compressed, but very short. Occiput strongly convex, with one pair of ridges on each side leading into tubes, directed obliquely inward from the upper posterior margin of each orbit. Tip of lower jaw without anterior unossified prolongations. Upper jaw length 2.1 into head, terminating slightly before a vertical from the anterior border of the eye. Premaxillary anteriorly with three long, depressible canines, followed by six retrorse, fixed canines and six antrorse fixed canines. Mandible with eight widely spaced canines, each accompanied by a short fixed tooth. Palatines anteriorly with four long, depressible canines, the last accompanied by a short fixed canine; after a space there are two short, fixed, retrorse canines in a single row. The last palatine tooth is slightly behind angle of gape. Tongue naked, but with a few rudiments of teeth near first basibranchial. Gill-teeth rudimentary, six bony raker bases, each with a single tooth, developed on ceratobranchial of first arch. A few pharyngobranchial teeth developed. Pseudobranchiae consisting of five long tufts.

Dorsal fin with nine rays. Origin of dorsal distinctly behind middle of body length, approximately one-third the distance between anal and pelvic fins behind the pelvic fins. Predorsal distance 1.7 into standard length. Dorsal to pelvic distance distinctly longer than either snout or upper jaw. Length of dorsal base 5.3 into head. Adipose fin low and long, free from caudal fin, over last anal rays. Anal rays 27. Length of anal base 5.9 into standard length.

Pectoral fins placed very low with 11 rays on both sides, their length 2.7 into head. Pelvic fins with 9 rays on both sides, far before middle of body length. Prepelvic distance 2.0 into standard length. Caudal with 9 + 10 rays.

Lateral-line with 60 segments, terminating over anterior portion of anal fin. Each lateral-line segment has rounded, shield-like, partly ossified sections. Each anterior section contains one pore above and below near the anterior margin. In the posterior sections there is the addition of a median pore, which is absent in the last segments over the anal fin.

*Coloration.*—Dorsal band very light and narrow, not extending onto lateral-line. Lateral-line and sides of body without pigmentation, except scattered chromatophores near caudal base. Mid-ventral line between anus and anal fin with eight chromatophores in a single line. Anterior rays of anal fin and upper ray of pectoral fin with scattered chromatophores. Other fins lacking pigment. Lightly scattered chromatophores on snout, lower part of mandible, supraorbital margin and suborbital region. Occiput fairly heavily pigmented.



TEXT-FIG. 4. Juvenile of *Lestidium affine* (Ege) 65.3 mm. in standard length. See "Explanation of Morphological Figures" (Pages 16 & 17).

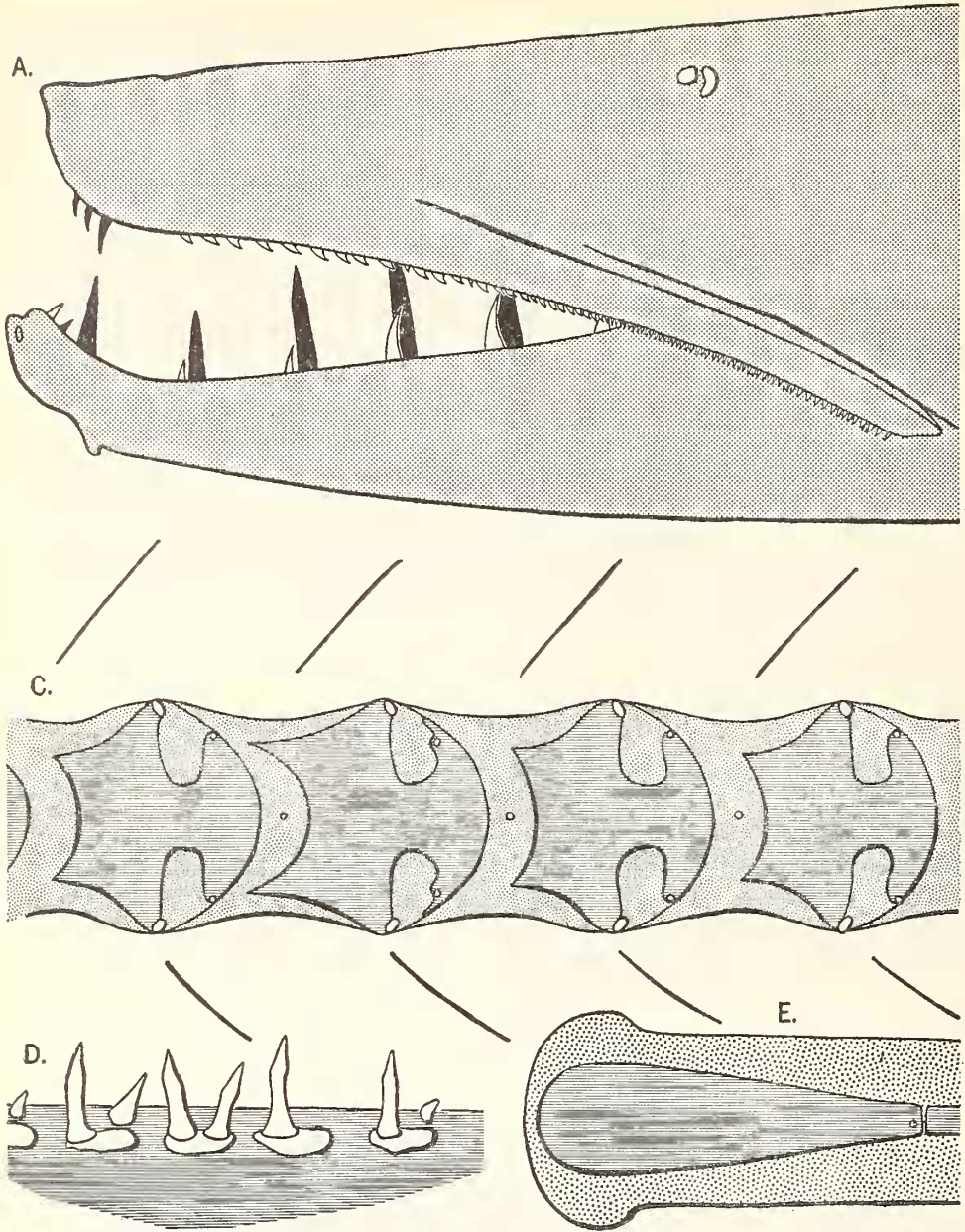
*Measurements in Percent. of Standard Length.* — Greatest body depth 6.7; least depth of caudal peduncle 2.9; length of caudal peduncle 36.1; length of head 16.2; length of snout 7.4; eye diameter 3.4; width of interorbital 2.9; predorsal distance 59.2; length of dorsal base 3.0; dorsal to pelvic distance 11.0; preanal distance 79.9; length of anal base 16.8; length of pectoral fin 6.1; length of pelvic fin 5.8.

*Lestidium pseudosphraenoides danae* (Ege).

Text-fig. 5.

*Material Examined.*—One specimen, 168.5 mm. in standard length, from Funchal Harbor, Madeira (taken at night near surface); Stanford no. 15,084; obtained from G. E. Maul.

*Specimens Previously Recorded.* — This subspecies is known from the 33 types, ap-



TEXT-FIG. 5. Adult of *Lestidium pseudosphyraenoides danae* (Ege) 168.5 mm. in standard length. See "Explanation of Morphological Figures" (Pages 16 & 17).

proximately 28-36 mm. in standard length, from the temperate North Atlantic, described by Ege (1930, p. 79) and four specimens, 100-187 mm. in standard length, from off Madeira, described by Maul (1945, p. 24).

*Description of Madeira Adult.*—Interorbital strongly concave, with two pairs of longitudinal ridges which diverge anteriorly. Occiput flat, with two pair of ridges on each side leading into tubes directed obliquely inward from the upper posterior margin of orbit. Premaxillary anteriorly with three depressible canines followed by 85 closely spaced, retrorse canines; the posterior teeth

tend to become antrorse. Tip of lower jaw with three prominent vertical unossified prolongations. Vomer toothless. Palatines anteriorly with three large, hooked canines, each accompanied by a short fixed tooth; posteriorly 11 short fixed canines in a single row. Last palatine tooth far behind angle of gape. Tongue (glossohyal) with a median fixed tooth near first basibranchial. Teeth well developed on all five arches. Each bony raker base with one or two short spines. Bony rakers on first arch 10 on hypobranchial, 16 on ceratobranchial, seven above angle on epibranchial. Gill-teeth begin below

middle third of eye. Pharyngobranchial teeth well developed in one oval patch on each side, consisting of about 25 depressible canines.

Lateral-line with 76 sections, terminating over a vertical from beginning of hind third of anal fin. Each lateral-line segment with the double-concave center shield characteristic of the genus *Lestidium*. Each anterior section contains two pores above and below near the anterior margin. In the middle sections there is the addition of a median pore between the partially ossified shields, but in the last sections over the anal fin there is only one pore above and below.

#### Genus *Macroparalepis* Ege.

The genus *Macroparalepis* is primarily characterized by (1) the presence of a foramen in the anterior process of the premaxillary, (2) upper jaw terminating at or slightly before a vertical from the anterior margin of the orbit, (3) supramaxillary closely bound to maxillary, (4) teeth on lower jaw well developed, basally round, not reduced in adults, (5) gill-teeth reduced, sub-equal, in a single row, (6) body naked in adults, (7) lateral-line sections distinctly deeper than long, (8) dorsum of body speckled with large chromatophores, (9) anus situated behind a vertical from the dorsal fin origin.

This genus includes four species from the North Atlantic and South Pacific. Two species of *Macroparalepis* were collected by the Bermuda Expeditions and a third is described from Madeira material. The species not included is *M. egei* Maul, which is known only from a single specimen.

#### *Macroparalepis brevis* Ege.

Text-figs. 6 & 7.

*Specimens Taken by the Bermuda Oceanographic Expeditions.*—Five specimens, 47.0-98.3 mm. in standard length; May 6, 1929, to July 25, 1934, at 500 to 600 fathoms; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

- No. 10,254; net 140; 500 F.; May 31, 1929; 55.1 mm.  
 No. 14,735; net 539; 600 F.; May 6, 1929; 47.0 mm.  
 No. 14,776; net 545; 600 F.; May 7, 1929; 56.6 mm.  
 No. 20,601; net 991; 600 F.; June 4, 1931; 53.5 mm.  
 No. 24,358; net 1503; 600 F.; July 25, 1934; 98.3 mm.

Vomer toothless. Palatines anteriorly with one to three fairly long depressible canines followed by 6-8 short, fixed teeth in a single row. Last palatine tooth far behind angle of gape. Tongue toothless. Gill-teeth rudimentary; in the largest specimen, 10 rakers on ceratobranchial of first arch, each with one or two spines. Pseudobranchiae consisting of five long tufts.

Lateral-line with approximately 60-68 segments, terminating over anterior portion of anal fin. Lateral-line segments large and deep, with rounded shield-like sections, without double-concave ossifications. Each lat-

*Specimens Previously Recorded.*—One adolescent 135 mm. in standard length from south-east of St. Helena (Lat. 19° 16' S., Long. 1° 48' W.), described by Ege (1933, p. 231).

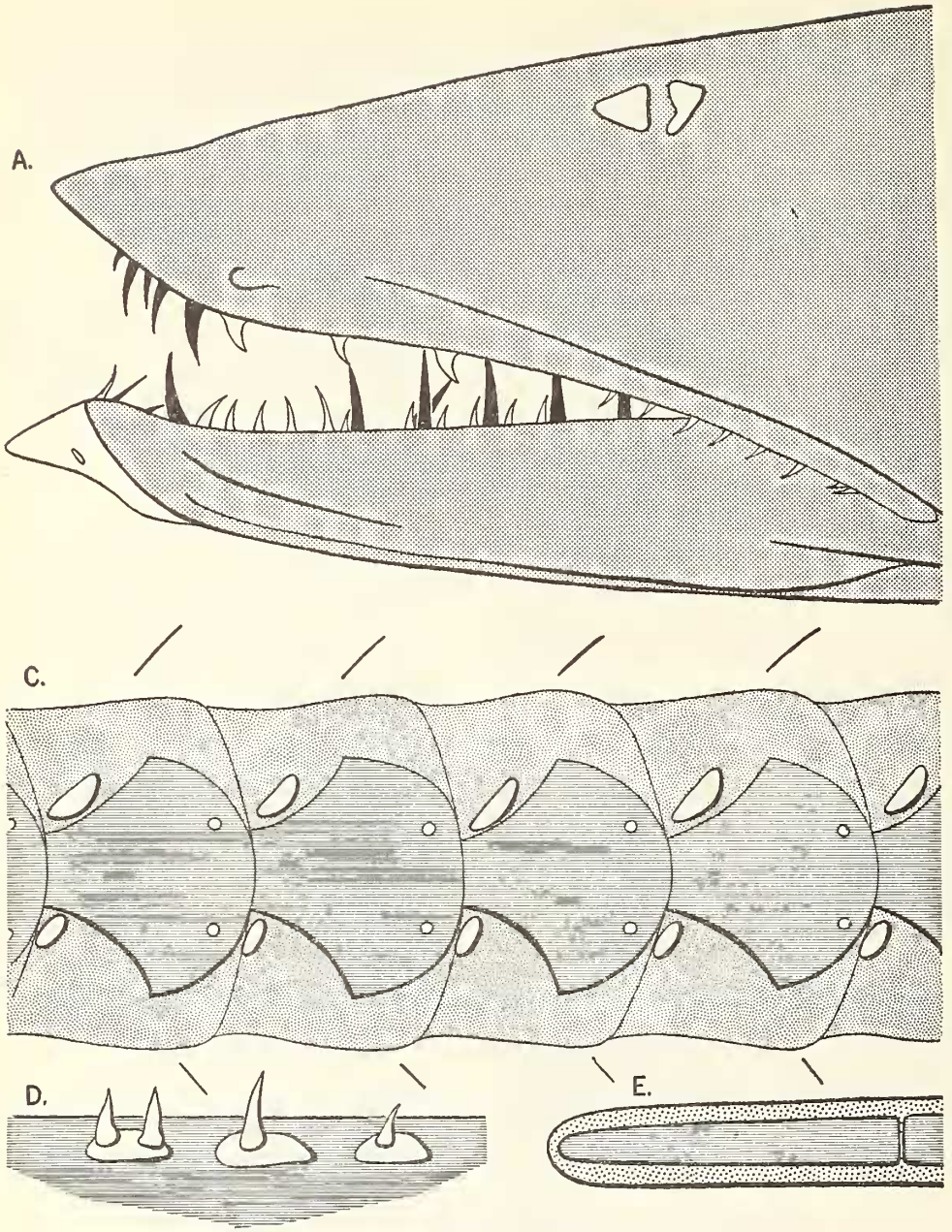
*Description of Bermuda Material* 47.0-56.6 mm.—In the counts and measurements, the mean is given first, followed by the range of three of the four specimens (no. 14,735 not in good enough condition to be counted and measured) in parentheses.

Body elongate, moderately short for a paralepid, compressed; greatest depth at nape 15.4 (14.5-16.2) into standard length. Ventral carina only slightly developed. No dorsal carina. Caudal peduncle depth 5.2 (5.1-5.5) into head; its length 3.3 (3.3-3.4) into standard length. Anus behind pelvic fin base and dorsal fin base, more than an eye diameter before a vertical from the dorsal fin.

Head large, slightly larger than body width; its length 5.0 (4.7-5.3) into standard length. Nostrils situated slightly less than one-half the length of the upper jaw before its posterior tip. Eye round, its length 4.7 (4.3-5.1) into head. Pupil round. Postorbital length distinctly less than snout or upper jaw length. Interorbital flat, with a single pair of sharp longitudinal ridges near the orbital margin; medially a closely spaced pair of rounded ridges extends onto the anterior part of the interorbital. Occiput convex, with a longitudinal median hump; with one (and vestiges of a second) pair of ridges on each side leading into tubes, directed obliquely inward from the upper posterior margin of each orbit. Tip of lower jaw with a hooked unossified prolongation. Upper jaw length 2.0 (1.9-2.0) into head, terminating slightly before a vertical from the anterior border of eye. In largest specimen, premaxillary with five long depressible canines in front, plus six retrorse fixed canines; behind are eight antrorse fixed canines. Smallest specimen with five depressible canines, plus six retrorse fixed teeth, followed by seven antrorse fixed canines. Mandible with approximately nine teeth in double series, the inner row depressible, the outer fixed.

eral-line section contains a very large pore above and below near the anterior margin, and one small pore above and below near the posterior margin. No median pores.

Dorsal fin with 12 (11-12) rays. Origin of dorsal fin distinctly behind middle of body length, approximately one-third the distance between the anal and pelvic fins behind the pelvic fins. Predorsal distance 1.4 (1.4-1.5) into standard length. Dorsal to pelvic distance distinctly shorter than either snout or upper jaw length. Length of dorsal base 4.3 (3.9-4.7) into head. Adipose fin low, free from caudal fin, over last anal rays. Anal



TEXT-FIG. 6. *Macroparalepis brevis* Ege 53.5 mm. in standard length. See "Explanation of Morphological Figures" (Pages 16 & 17).

rays 22 (20-24). Length of anal base 6.5 (6.4-6.6) in standard length. Pectoral fins fairly low, with 10 (10) rays on each side. Pelvic fins with 9 (9) rays on each side, situated slightly before middle of body length. Prepelvic distance 1.6 (1.6-1.7) into standard length. Caudal fin with 9+10 (9+10 or 10+10) rays.

*Coloration.*—Dorsal band with large and small chromatophores, appearing to be speckled, extending down upon upper border of lateral-line. Five long, slender, peritoneal color segments developed posteriorly to

above pelvic fins. Scattered chromatophores on jaw, snout and occiput.

*Description of Bermuda Specimen of 98.3 mm.*—Since this adolescent is different in many respects from the other four specimens it is described separately. Unless otherwise indicated, this specimen agrees with the description of the smaller specimens.

Stomach full of a great number of post-larval fish. Greatest depth of body somewhat before pelvic fins. Anus midway between appressed tips of pelvic fins and anal fin origin. Interorbital with a low longitudinal

ridge on each side near orbital margin and a low median hump in the center. Occiput convex, with a low median longitudinal keel; a single pair of ridges on each side are directed obliquely inward from the upper posterior margin of orbit; these ridges are covered over and do not form a trough or tube. Occiput posteriorly with one pore on the left and two pores on the right side penetrating the cranium. Anterior unossified prolongation on tip of lower jaw greatly reduced from the condition found in the smaller specimens. Premaxillary anteriorly with five fairly long depressible canines which are followed by 10 retrorse canines and 11 well developed antrorse canines. Mandible with approximately 12 well developed depressible canines and a greater number of fixed teeth in the outer row. Palatines anteriorly with two or three fairly long depressible canines followed by a single row of 12 short, fixed canines. Gillrakers rudimentary, one raker at posterior end of hypobranchial, 11 on ceratobranchial and several above angle on epibranchial. Pseudobranchiae consisting of nine tufts.

Lateral-line with 69 segments, terminating over middle of anal fin. The anterior sections are more than twice as high as long.

Dorsal rays 11. Anal rays 23. Pectoral rays 11. Pelvic rays 9, the fin situated at middle of body length.

*Measurements in Percent. of Standard Length* (All four specimens included; the mean is given first, followed by the range in parentheses).—Greatest body depth 6.8 (6.2-7.9); least depth of caudal peduncle 3.7 (3.5-4.2); length of caudal peduncle 29.2 (27.1-30.4); length of head 19.1 (18.2-21.4); length of snout 8.9 (8.3-9.9); eye diameter 4.3 (4.1-4.5); width of interorbital 3.1 (2.8-3.6); predorsal distance 68.1 (66.4-71.5); length of dorsal base 4.8 (4.5-5.5); distance between dorsal and pelvic fins 7.1 (5.8-8.5); dorsal to pelvic distance 7.1 (5.8-8.5); distance between a vertical from dorsal fin origin and anus 4.9 (4.5-5.8); preanal distance 81.1 (78.9-84.0); length of anal base 14.9 (14.1-15.5); length of pectoral fin 5.8

(4.7-6.5); length of pelvic fin 5.2 (4.9-6.0); prepelvic distance 60.0 (59.8-61.3).

#### *Macroparalepis affine* Ege.

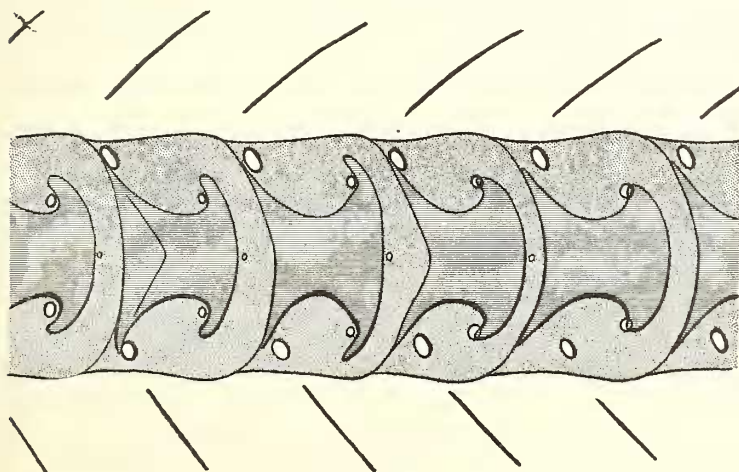
*Material Examined.*—One specimen, 128.5 mm. in standard length, from near Funchal, Madeira, from the stomach of *Alepisaurus ferox* Lowe (caught on tunny-hook at about 100 fathoms); originally Museu do Funchal no. 3005; now Stanford no. 15080; obtained from G. E. Maul.

*Specimens Previously Recorded.*—This species is known in the literature from nine specimens, 56.5-156 mm. in standard length, from off the north-west coast of Africa, described by Ege (1933, p. 231; holotype from south-west of Canary Islands) and Maul (1945, p. 28; eight specimens from off Madeira).

*Description of Madeira Adult.*—This specimen has been described and figured by Maul (1945), but additional notes are presented in the light of my own investigations.

Interorbital with numerous ridges. Occiput keeled and with six ridges on each side directed obliquely inward from upper posterior margin of orbit; all ridges covered over, and not leading into open tubes. Premaxillary anteriorly with three depressible canines followed by 38 fixed canines. Vomer toothless. Palatines anteriorly with five long depressible canines accompanied by short fixed teeth; posteriorly three large, widely spaced, retrorse canines. Last palatine tooth distinctly behind angle of gape. Tongue (glossohyal) with many teeth in two longitudinal series. Two teeth on first basibranchial. Gillrakers partially developed on first two arches. Each raker with two or three short teeth. Gillrakers on first arch comprising 15 on hypobranchial, 23 on ceratobranchial, and nine above angle on epibranchial. Gillrakers begin below anterior part of eye. Pharyngobranchial teeth reduced in number, confined to a single patch on each side. Pseudobranchiae well developed, consisting of 10 tufts.

Lateral-line with 87 sections, terminating slightly before a vertical from hind margin



TEXT-FIG. 7. Lateral-line of a specimen of *Macroparalepis brevis* Ege 98.3 mm. in standard length, illustrated in the same manner as figure C of the morphological drawings. This illustration is to be compared with figure 6C in order to show the changes that can take place in the lateral-line form between different growth stages. Except in *Sudis hyalina*, there is usually very little change in lateral-line form in the various growth stages of paralepids.

of anal fin. Each lateral-line section with double-concave center shields. Each anterior section contains two pores above and below. Most sections have a median pore.

Anus slightly behind pelvic fins which are below middle of dorsal fin.

This specimen is illustrated by Maul (1945) and in the generic review in press.

***Macroparalepis danae* Ege.**

*Specimens Taken by the Bermuda Oceanographic Expeditions.*—Two specimens, 26.6 and 40.8 mm. in standard length; no 11,195; net 243; 600 fathoms; July 1, 1929; from a cylinder of water eight miles in diameter (five to thirteen miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12' N. Lat., 64° 36' W. Long.

*Specimens Previously Recorded.*—One adolescent 121 mm. in standard length, from south-west of Fiji Islands (20° 00' S. Lat., 174° 29' E. Long.), described by Ege (1933, p. 230).

*Description of Bermuda Material.*—The two Bermuda specimens are in poor condition, having dried out at one time. Despite the fact that the type was from near Fiji, these specimens agree quite well with Ege's description, for instance in the position of the pelvic fins far before a vertical from the dorsal fin, and similar counts and proportions. These two specimens are only tentatively identified with this species, and the record of this species from the Atlantic should be questioned until confirmed by other material.

***Stemonosudis*, New Genus.**

*Macroparalepis* (in part) Ege, 1933, p. 229.

This genus comprises group II of *Macroparalepis* as delimited by Ege (1933). It is primarily characterized by (1) the presence of a foramen in the anterior process of the premaxillary, (2) upper jaw terminating approximately an orbital diameter before the anterior margin of the eye, (3) supramaxillary closely bound to maxillary, (4) teeth on lower jaw moderately developed, basally round, (5) gill-teeth reduced, subequal, in a single row, (6) body naked, (7) lateral-line sections approximately twice as long as deep, (8) dorsum of body not evenly pigmented, with saddle-like blotches, (9) anus situated in front of a vertical from dorsal fin. This genus is fully described in the generic review of the Paralepididae by the present author (in press).

Generic type *Stemonosudis intermedia* (Ege). It is presumed that *Macroparalepis macrura* Ege, *M. elegans* Ege, *M. elongata* Ege and *M. gracile* Ege belong to this genus, although I have been unable to examine any of them.

***Stemonosudis intermedia* (Ege).**

*Specimens Taken by the Bermuda Oceanographic Expeditions.*—One adolescent, 125 mm. in standard length; original no. 13,101;

now Stanford no. 15,356; net 423; 500 fathoms; Sept. 5, 1929; taken approximately at 32° 12' N. Lat., 64° 36' W. Long., off Nonsuch Island, Bermuda.

*Specimens Previously Recorded.*—One adolescent 144 mm. in standard length, from the Caribbean Sea (13° 47' N. Lat., 61° 26' W. Long.), described by Ege (1933, p. 235).

*Description of Bermuda Adolescent.*—Body eel-like, very elongate and thin; greatest depth at nape, 43.1 into standard length. No carinae. Caudal peduncle depth 9.0 into head; its length 2.8 into standard length. Anus a snout length before pelvic fins.

Head long and slender, slightly wider than body width, its length 7.7 into standard length. Snout very elongate, distinctly longer than remainder of head, its length 1.7 into head length. Nostrils distinctly behind a vertical from upper jaw. Eye very small, round, its diameter slightly greater than interorbital width, 9.0 into head length. Postorbital length one-half of snout length. Interorbital flat, with two pairs of high, compressed, longitudinal ridges, extending forward on snout; median pair terminates on interorbital; ridges of lateral pair diverge posteriorly, following upper orbital margin. Occiput with a pair of short ridges directed obliquely inward from the upper posterior margin of the eye; these ridges do not become roofed over, or enter tubes. Upper jaw length 2.2 into head length, terminating approximately one and one-half eye diameters before eye. Angle of gape at posterior tip of maxillary. Dentition very weakly developed. Premaxillary anteriorly with four closely spaced, depressible canines, followed by 28 fixed teeth. Mandible with fairly short canines in two series; fixed teeth on edge of jaw bone and depressible canines on inner face. Vomer toothless. Palatines anteriorly with four fixed teeth followed by two longer depressible canines, each accompanied by a short, fixed tooth; posteriorly, after a short gap, four widely spaced, fixed canines. Tongue (glossohyal) far forward, its tip an eye diameter before posterior end of upper jaw; no teeth on glossohyal or basibranchials. No gill-teeth or pharyngobranchial teeth yet developed. Pseudobranchiae consisting of seven tufts. Branchiostegal rays seven on both sides. The left branchial membrane overlaps the right.

Lateral-line tube with 92 sections, terminating over middle of anal fin. Every segment is twice as long as high and contains a double-concave center shield. Each segment has two pores above and below and generally a median pore.

Dorsal fin with 10 rays, its origin distinctly behind middle of body length. Dorsal fin approximately a head length behind the pelvic fin origin. Predorsal distance 1.6 into standard length. Anal rays 42. Length of anal base 4.9 into standard length. Pectoral fin rays 11 on both sides. Pelvic fin rays eight on both sides. Inner pelvic rays longer than outer rays. Principal caudal rays 9+10.



**Coloration.**—No mid-dorsal band, but only sparsely scattered chromatophores which are particularly concentrated in five saddle-like patches on back, starting at base of dorsal fin. These patches alternate with similar blotches above anal fin. A few scattered pigment cells on mid-ventral line. Otherwise no pigmentation on body. Head with scattered chromatophores on snout, lower jaw, sub-orbital, interorbital and occiput. Greatest pigmentation on head is a patch on top of middle of snout.

**Measurements in Percent. of Standard Length.**—Greatest body depth 2.3; least depth of caudal peduncle 1.4; length of caudal peduncle 35.7; length of head 13.0; length of snout 7.6; eye diameter 1.4; width of interorbital 1.3; predorsal distance 64.7; length of dorsal base 1.8; dorsal to pelvic distance 10.5; distance between a vertical from dorsal fin and anus 19.4; preanal distance 76.3; length of anal base 20.2; length of pectoral fin 5.3; length of pelvic fin 3.0; prepelvic distance 53.9.

This form is illustrated in the generic review in press.

#### Genus *Sudis* Rafinesque.

The genus *Sudis* is primarily characterized by (1) the lack of any foramen in the anterior process of the premaxillary, (2) upper jaw terminating somewhat before a vertical from anterior border of eye, (3) supramaxillary closely bound or fused to maxillary, (4) teeth on lower jaw well developed, triangular, with serrate edges, (5) gill-teeth reduced, subequal, in a single row, (6) head scaled on preoperculum; otherwise head and body lacking scales.

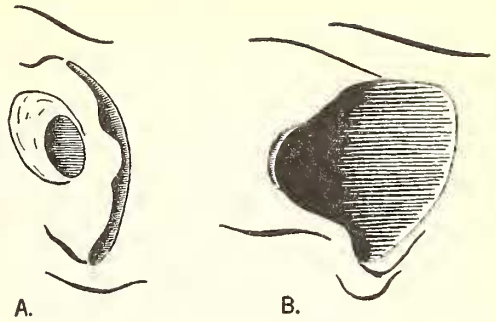
This genus includes only a single species known from the Mediterranean and off Madeira. The Bermuda Expeditions did not collect this genus.

#### *Sudis hyalina* Rafinesque.

Text-figs. 8 & 9.

**Material Examined.**—Three specimens 125.9-320 mm. in standard length, from the Mediterranean and off Madeira.

**Specimens Previously Recorded.**—Apparently only a few specimens (about 25) of this supposedly well-known species have been recorded in the literature, and most of the accounts of this form were published about the middle of the 19th century. I have been unable to see all the references concerning *Sudis hyalina* because a considerable portion of the early Italian literature by Verany, Costa, Bellotti, Cocco and Doderlein was unavailable. Unfortunately none of the recent papers mentioning *Sudis hyalina* (Ege, 1930; Maul, 1945; and Parr, 1928) have included an adequate survey of the literature on this species. Apparently the only 20th century paper describing adults is by Maul (1945, p. 34). The only paper on the early growth stages is by Sanzo (1917). The best 19th century descriptions and figures appear to be those of Bonaparte (1832-41), Cocco

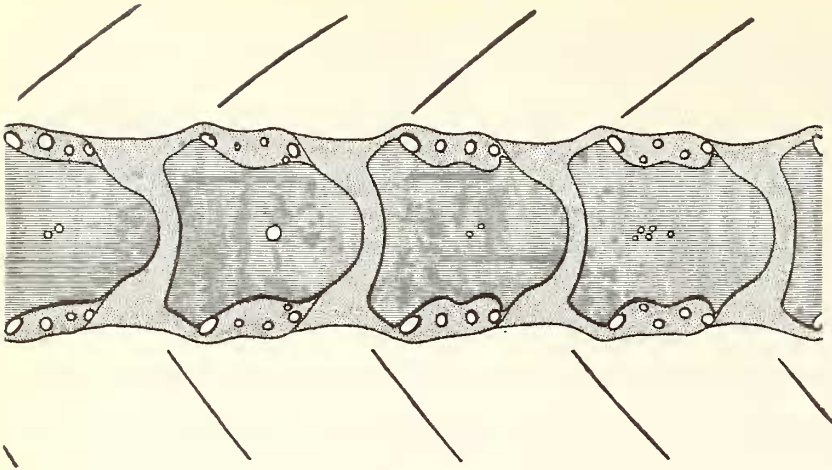


TEXT-FIG. 8. Nostrils of *Sudis hyalina* Rafinesque. The head is facing left. **A.** Anterior and posterior nostril of a specimen 125.9 mm. in standard length. **B.** Nostrils of a specimen 300 mm. in standard length; the anterior nostril is reduced to a small slit in the front border of the posterior nostril.

(1839) and Costa. Canestrini (1872, p. 127) records *Sudis hyalina* from Sicilia, Napoletano and Liguria. Carus (1893, p. 567) mentions it from Nizza, Genova, Napoli, Catania and Calabria.

Since specimens of *Sudis hyalina* are particularly rare in museums, it is of interest to record what I have learned about the distribution of preserved material. Apparently there are no representatives in New World institutions except those used for the present study at Stanford University. These were recently obtained from the H. H. Giglioli collection mentioned below. Dr. Ethelwynn Trewavas has informed me that the British Museum (Natural History) has two specimens. Mr. G. E. Maul presented them with a large adult which the British Museum kindly lent me for the present study. Maul has written me that he has only one specimen at Madeira now. Dr. Enrico Tortonese very graciously checked numerous Italian museums for examples of *Sudis hyalina* and obtained interesting results. The Istituto e Museo di Zoologia of the University of Torino has but one large adult from Naples, Italy. The Genoa Museum, which has the largest ichthyological collection now existing in Italy, has only one specimen from the Ligurian Sea. The small fish collection of the Stazione Zoologica di Napoli has six specimens, including a large adult. The Museo di Storia Naturale di Firenze probably has the largest existing series of this form, which was assembled many years ago by the late H. H. Giglioli. There is one adult from Palermo, Sicily, two adults and five juveniles from Messina, Sicily, four specimens from Catania, Sicily, and two adults from Naples, Italy. Dr. Tortonese also found mention in Giglioli's manuscript notes of specimens in the small museums of the Universities of Catania and Palermo, and that a specimen from Naples was preserved in Bellotti's collection (Museum of Milano) which was destroyed during the last world war.

**Description of Mediterranean Subadult of 125.9 mm.**—Interorbital convex with a



TEXT-FIG. 9. Lateral-line of a specimen of *Sudis hyalina* Rafinesque 125.9 mm. in standard length, illustrated in the same manner as figure C of the morphological drawings.

median longitudinal depression paralleled on each side by a single low closed tube; interorbital lacking ridges. Occiput slightly concave, with two pairs of ridges on each side (but not open and leading into tubes) directed obliquely inward from the upper margin of the orbit. Surface of these covered tubes is pierced by numerous pores. Pre-maxillary anteriorly with one tiny depressible tooth followed by 11 minute teeth which insensibly grade into a rough-edged pre-maxillary. Tip of lower jaw without anterior unossified prolongations. Vomer toothless. Palatines anteriorly with one fairly short fixed tooth followed by a longer depressible canine. Palatine teeth near tip of snout. Tongue toothless. Mandible anteriorly with two tiny, retrorse canines near tip of jaw; behind these are five large, fixed, antrorse canines; these teeth are broad and flattened and have serrate anterior and posterior margins. On each side of snout are two nostrils separated by a thin membrane; the anterior nostril is smaller, in a short posteriorly directed tube. Gillrakers partially developed; each raker consisting of a small base with two short spines. Gillrakers on first arch nine on hypobranchial, 25 on ceratobranchial, and eight above angle on epibranchial. Gillrakers begin below anterior part of eye. Pharyngobranchial teeth in one oval patch on each side.

Lateral-line with 63 sections, terminating behind anal fin near the beginning of the pre-current caudal rays. Each anterior lateral-line segment with an elongate center shield that has slight indentations. Each anterior section contains 4-5 pores above and below the center shield; in last segments there are one or two pores above and below; rarely is there a median pore. True scales developed on preoperculum in two series. Otherwise body and head naked.

Pectoral fins as long as distance from snout tip to preopercular margin. Pelvic fins with outer rays distinctly longer than inner rays.

*Description of Mediterranean and Madeira Adults of 300 and 320 mm.*—Except where indicated as otherwise, these speci-

mens agree with the description of the subadult presented above.

The ridges on the occiput lead into two tubes on each side, instead of being closed as in the subadult. Edge of premaxillary finely serrate, without anterior depressible canines. Mandible with two tiny teeth near tip of lower jaw, followed by eight fixed teeth. On the inside of the fixed teeth is another series of partially formed teeth, which are depressible and pointing obliquely inward and posteriorly. Palatines anteriorly with a single fairly large fixed tooth followed by 2-3 larger depressible canines; posteriorly 12-14 tiny retrorse fixed canines in a single row; all of these palatine teeth basally round. On each side of snout is a single large nostril; in the anterior border of this nostril is a minute anterior nostril. Gill-teeth developed on first two arches only; each raker with two short spines. Gillrakers on first arch 21-23 on hypobranchial, 24 on ceratobranchial, 9-11 above angle on epibranchial. Gillrakers begin midway between eye and upper jaw.

Lateral-line with 71-75 sections, extending onto hypural fan. Each lateral-line segment with circular overlapping scale-like shields, which are pierced by pores above and below.

Pectoral fins as long as snout.

The 300 mm. specimen is figured by Maul (1945) and in the generic review in press.

*Discussion of Relationships.*—While the above specimens, approximately one foot long, are large for paralepids, the incomplete development of the gill-teeth probably indicates that these specimens are not fully grown. Most of the so-called adult specimens of the scaled genera and of many of the naked genera also do not appear to be fully grown, and it is probable that the true adults are so swift that they have evaded collectors' efforts to catch them.

*Sudis hyalina* is the most unusual paralepid known, and it is difficult to trace its relationships. The presence of only a few weakly developed scales on the preoperculum would superficially place it in an intermediate position between the scaly and naked

genera of the family. The dentition of the premaxillary is very much like that of the most primitive scaly genus in the family (new genus, in press). The gillraker form, distribution of pharyngobranchial teeth, lack of body squamation, general body and particularly head form, and lateral-line form is clearly the same in many respects as in *Lestidium* and the other naked genera. *Sudis* is different from all other paralepids in many respects. So far as known it is the only paralepid (1) without a foramen in the anterior process of the premaxillary, (2) with the anterior nostril vestigial in the adult, (3) with broad, flattened, mandibular teeth, (4) with serrate teeth, (5) with the greatly enlarged teeth in the lower jaw fixed, (6) with enlarged pectoral fins, (7) with the outer rays of the pelvic fins longer than the inner rays, and (8) with the supramaxillary fused to the maxillary in the adult. It is expected that further study of the osteology of this form will reveal more of its relationships and differences. On the basis of our present knowledge it seems that *Sudis* must have split off early from the remainder of the family and followed in many respects the evolutionary pattern of the naked genera of the subfamily Paralepidinae.

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